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UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SUMMARY REVIEW OF MONTHLY REPORTS[1]
FOR
SOIL CONSERVATION SERVICE--RESEARCH[2]
March 1952

EROSION CONTROL PRACTICES DIVISION

Effect of Cultivation Versus No Cultivation on Runoff and Crop Yields - G. D. Brill, New Brunswick, N. J.

"In 1948 we started an exploratory study on the effect of cultivation versus chemical weed control with no cultivation on runoff and crop yields. Two plots were established and equipped to measure runoff. Field corn was grown on both plots and treatment was identical with the exception of cultivation. We cultivated one plot with hand tools just enough to control weeds. Two to three shallow cultivations were found to be enough. A small garden plow was used to ridge the rows slightly at the last cultivation. We tried a chemical weed killer on the other plot. It didn't control the grasses so we singed the weeds off with a torch two or three times to get weed control without cultivation.

"During the period 1948 through 1950 the corn was planted up and down the slope. Average runoff and corn yields are shown in table 1:

Table 1.--Average annual soil and water losses and corn yields from cultivated and uncultivated areas in field corn during the period 1948-50

Treatment	Runoff	Soil loss	Corn yields
	Inches	Lbs./acre	Bu./acre
Cultivated	2.84	4,260	80
Uncultivated	3.15	4,130	63

"Average soil losses were slightly higher from the cultivated plot. However, runoff was reduced about 10 percent by cultivation. Both soil and water losses were generally higher from the uncultivated plot during the early part of the season. This tendency reversed after cultivation ceased indicating some structural deterioration of the soil due to cultivation:

"In 1951 the corn was planted on the contour with no other change in treatment. Results are shown in table 2 on the next page."

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[2]All research work of the Soil Conservation Service is in cooperation with the various State Experiment Stations.

Table 2.--Soil and water losses and corn yields from cultivated and uncultivated areas in field corn planted on the contour - 1951

Treatment	Runoff	Soil loss	Corn yields
	Inches	Lbs./acre	Bu./acre
Cultivated	0.75	2,860	79
Uncultivated	3.67	7,250	73

"With the corn planted on the contour, three shallow cultivations saved nearly 3.0 inches of water and 4,400 lbs. of soil. The last cultivation provided sufficient storage capacity between rows to practically eliminate runoff from subsequent storms.

"Corn yields were increased 8 percent by cultivation, much less than in previous years when the rows ran up and down hill. Since rainfall was adequate and well distributed during the growing season this small yield increase may be due to greater leaching of fertilizer on the cultivated plot where more water was absorbed."

Determination of Relative Production Probabilities on Wet Sandy Soils (Cormant-Redby) and Heavier Soils (Nebish-Shooks) - H. O. Anderson, La Crosse, Wis.

"Data obtained from 58 records through the cooperation of Einar Nordby, Chairman of the Beltrami Soil Conservation District Board of Supervisors and Al Good, Veteran Trainer in the Kelliher Area, were summarized and analyzed. These records were grouped according to major soil types found on the cropland areas of the farms.

"Farm records from this areas were summarized to determine relative production probabilities on wet sandy soils (Cormant-Redby) and heavier soils (Nebish-Shooks). Definite conclusions cannot be made from the summaries presented because the number of records is small and the period covered is short. A comparison of production and income between the two groups nevertheless may be of interest.

1. The records, on which this report is based, are from farms operated by G. I. trainees who recently have begun farming. The set-up on these farms differ in many respects from other farms in the area.

2. Their inventory values are higher than those of farms established during periods of lower prices. The cost of operation, particularly of overhead costs, therefore, are higher on the G. I. farms.

3. Some of the farms were low in fertility at the time these men started farming. Where this is the case, there will be an 'extra' cost to bring this land into 'good' production.

4. Capital has been a limiting factor in many cases--thus there has been a tendency towards skimping on fertilizer, and feed purchases as well as in the purchase of a large enough number of good diary cows.

5. As a result of a combination of factors such as these, crop yields most likely are lower than the average for 'better' established farms on similar soil types. The total production as well as the total and net

incomes no doubt are lower than that obtained on the older farms.

6. These records, therefore, may be of more value as guides for new farmers than for those that are well established. Much could be said about social and psychologic forces that sometimes outweigh economics when farmers make decisions.

7. The wet sandy soils returned a little under 3 percent on the investment in the farm (assuming a labor and management wage of $90 per month for the operator). The Nebish-Shooks farms showed a return of 4-1/2 percent on the investment. Prospective owner-operators of farms on the former soils can scarcely be expected to pay for their farms from the production of the land, under the existing methods, etc., unless they they are willing to curtail expenditures for family living.

8. Data are needed on production probabilities for both soils groups (the wet sands and the heavier soils) after drainage and with good cropland management. This can be obtained from special studies of a few well-drained and well-managed farms for each problem group. There seems to be little or no question but that it will be profitable to invest in land improvement operations on the Nebish soils. It is possible that drainage and improved practices will make farming profitable on the less productive soil. There will have to be a material increase in crop yields if this improvement in net income is to be realized.

9. There doosn't seem to be too much of a chance to pay off an indebtedness nor to build up a reserve for cost of drainage of the wet sandy soils. The cost of these will have to be taken care of by an over-all financing plan. That is, for farmers that are short of cash and that probably includes a large share of the beginners."

Brush Control and Pasture Development Investigations - H. A. Daniel, Guthrie, Okla.

"Our brush control and pasture development investigations continue to be very popular. Scrubby brush and other worthless plants are choking off production on nearly 100 million acres of range land in the great Southwest. In Oklahoma alone it is estimated that beef production could be increased by 100 million dollars annually if the blighted land were cleared of noxious species. Six other cattle-producing States--Texas, New Mexico, Arizona, Arkansas, Kansas, and Colorado-- are in the same predicament as Oklahoma.

"Where selective herbicides are properly used and fires prevented, the soil is protected with an adequate cover from mulches of dead brush. If brush control is applied to land suitable for clearing, a complete land cover and full grass production can be obtained in about 3 years. The cleared woodland pastures are producing five to eight times more hay and beef than uncleared lands. This method, therefore, has been the safest way to change worthless brush land into valuable grass land. In fact, measurements made during an 8-year period on this station show that 45 percent less water ran off annually from good grass on cleared land than from an adjacent area of brush land."

Erosion Control Practices - B. H. Hendrickson, Watkinsville, Ga.

Summary of Long-Time Runoff Plot Data -

1. The annual runoff and erosion hazard during the time oats occupy the land represents roughly one-half of the total annual hazard since 69 percent of the annual rainfall, 65 percent of the annual runoff, and 47 percent of the annual erosion as judged by continuous cotton on Class III land occurs during the 8-month period from date of planting to grain harvest of the oats crop.

2. Oats, regardless of the method of planting effect a substantial reduction in runoff and erosion, the reduction in erosion being the more important.

3. Furrow planted oats allow one-fourth less runoff and only one-half as much erosion as drilled oats.

4. Steps need to be taken to provide a suitable means of furrow-planting oats with modern farm machines in cotton middles in the Southeast. Such a project has been initiated on this Station.

Agronomy - "Four years' experience with fescue and orchard grass with legumes in rotations indicate that grass-based rotations are promising. The 2- and 3-year old grass has been turned in late March, a good seed-bed prepared for cotton and corn, and good stands secured. Both of the perennial grasses were killed and no trouble was experienced in cultivating the rowcrops. Yields in 1951 following these grasses were 63.5 bushels per acre of corn and 2,300 pounds per acre of seed cotton.

"A study was started in October 1941 in which nine legumes were seeded individually and in various combinations with tall fescue grass. The alfalfa is the more promising summer legume, so far; and crimson clover, bur clover, Caley peas and smooth vetch the more promising winter legumes. The winter legumes have successfully volunteered for 2 years.

"The rotation studies include legumes such as vetch which are seeded each fall as well as volunteering legumes like Caley peas, smooth vetch, and button clover which are allowed to mature a seed crop either every year or every other year. The stands, growth, and yields of the volunteering legumes have always exceeded the legumes which are seeded, when they were turned about April 1 for green manure. The fall and winter growth may have been less with the volunteering legumes, though they have produced the most total green weight when turned.

"Nine years' results with cotton, corn, and peanuts in a large number of rotations have shown that as the plant residues are increased in the rotations, the fertilizers became more efficient."

Need for Good Soil Erosion Practices - E. L. Sauer, Urbana, Ill.

"Long-time land-use recommendations show the urgent need for increasing the acreage of both green manure catch crops and standover legumes and grasses in Illinois. More widespread application of good farming practices is the key t getting increased agricultural production in 1952. Productive capacity of Illinois agriculture shows that if the best combinations of proven practices

were used on all farms, Illinois farm production could be increased from 50 to 80 percent.

"Increasing acreages of intertilled and grain crops at the expense of sound land use will lower total farm production over the next 3 to 5 or more years. Studies show conclusively that well-planned systems of farming that conserve the soil, increase total production, and are profitable under a wide variety of conditions. The present goal of maximum farm production can best be achieved by emphasizing sound conservation plans on all farms.

"The costs and benefits of conservation section for the Carthage Lake watershed pointed out the present land use and practices and their divergence from recommended land use and practices. The need for land use and crop rotations in accordance with soil capabilities and the increased application of supporting practices and soil fertility treatment was pointed out. It was also pointed out that the costs of conservation in the watershed would be approximately $38 per acre if primarily vegetative methods are used. However, if structures are used to control the velocity of runoff water in the gullies the conservation costs are approximatel $95 an acre for the watershed. It is reasonable in this author's opinion to assume that the silting of Carthage Lake can be greatly reduced without the use of expensive structures and at a cost that can be economically justified by the farm owners and operators in the watershed."

Soil Conservation Practices - R. M. Smith, Temple, Tex.

"Ground cover and soil protection by small grain crops are now excellent as we approach the April-May season when there is maximum danger of heavy soil and water losses on cultivated land. Fescue grass, with legumes, is now making considerable growth, and has the soil well protected. In the Bermuda-grass waterway pasture, rescuegrass, Texas wintergrass, and little wild barley are prominent and are providing excellent grazing. Some wild vetch (Vicia leavenworthi), milk vetch (Astragalus nuttallianus), and spring forbs are also contributing. The Bermudagrass has started some significant growth. K. R. Bluestem and Johnsongrass were both set back noticeably by the frost of March 24, but new growth has started again at the end of the month. Common bur clover, button clover, and other related legumes (probably black medic and hop clover) are giving good ground cover and grazing in one part of the K. R. Bluestem pasture where legumes were seeded 2 years ago. The same is true of certain patches of the buffalograss pasture near the office. The presence and growth of these cool season legumes appears to be a great advantage in our pastures of warm season grasses. The maintenance of an abundance of such species by proper treatment and management should probably represent a major objective of our forage work."

Soil Conservation Practices - C. J. Whitfield, Amarillo, Tex.

Crop Rotations - "Soil-moisture samples were taken February 27, 1952, on plots in various cropping systems to determine the amount of available soil moisture in the top 3 feet of soil. The plots sampled were wheat on fallow in a wheat-sorghum-fallow rotation, continuous wheat, continuous sorghum, native buffalo-blue grama grass, hairy vetch seeded in fall of 1951, fallow following Madrid clover, fallow following hairy vetch, fallow after wheat, and fallow after sorghum."

Legumes - "Some plots of hairy vetch and second year Madrid clover were one-wayed on June 27, 1951. Some wheat adjacent to the legume plots was abandoned and

onewayed at the same time. Since then all plots have been followed. There was about 3,100 pounds air dry weight of tops of each legume containing over 90 pounds per acre of nitrogen. Nitrates run on the top 3 feet of soil on March 1 showed 66, 66, and 80 pounds per acre of nitrate-nitrogen on the old wheat, sweet clover, and vetch plots respectively. To date little additional available nitrogen seems to have resulted from turning under the legumes. The dry condition of the topsoil during the fall and winter may have been unfavorable for nitrification of the residues. Also, soil temperatures may also have been exceptionally high during the summer months. The behavior of these plots will be watched after spring rains are received.

Grass Studies at Hastings Watershed Project - F. L. Duley, Lincoln, Nebr.

"Plans have been made for grass seeding studies at Hastings Watershed project. Also methods of treatment of established stands in order to get higher yields of high quality forage are being given more attention this year. The studies made on this land in the past have given much encouragement to the idea that badly eroded land in south central Nebraska can be made to produce good crops that will give effective erosion control. This soil is low in nitrogen and consequently legumes are a very important link in the cropping system. Some legumes new to this region are being tested. Among these are birdsfoot trefoil and milk vetch."

Alta-Fescue Pasture Results - D. D. Smith, Columbia, Mo.

"The 5-acre alta fescue pasture carried 13 head of long-yearlings through most of the winter. Grazing began December 5 and ended March 11. Snow cover made it necessary to give the cattle access to the hay stack on December 14. Hay was harvested and stacked in the plot after seed harvest last July. It was observed, however, that they went to the stack only when they were unable to get a fill from the pasture.

"It was interesting to note the manner in which different animals went through the winter. Four of the 13 gained weight, 7 lost weight, and 2 did not change in weight. Highest gain was 65 pounds per head, and greatest loss was 57 pounds. The 13 yearlings lost an average of 9 pounds per head in the 96-day period.

"One acre of the pasture is still being grazed to determine the effect of grazing when the ground is soft and subject to perforation by animal hoofs."

Soil and Water Losses from Plots on 3 Percent Slopes of Tifton Sandy Loam - G. N. Sparrow, Tifton, Ga.

"Throughout the late fall and winter, the least soil and water losses from plots on 3 percent slopes of Tifton sandy loam have been experienced consistently from plots (1) in Coastal Bermuda grass sod with Crimson clover, (2) with corn crop residue on the surface, and (3) with oats stubble and crotalaria harrowed into the surface. The losses under those conditions have been appreciably lower than from six other plot conditions. Blue lupine, oats, and Crimson clover, all having been planted in the fall, lost heavily of water.

"It appears that annual winter cover does not conserve water materially. Perennial cover, in the form of Coastal Bermuda grass sod, on the other hand, seems to provide an adequate reservoir for rainfall. It is indicated that the plowing of an area in annual winter legumes improves the ability of the soil in that area to absorb water, particularly from rains of moderate intensity. It further appears

that the residual ability of crop residues to impart water absorbing and holding capacities to the soil continues after harrowing into the surface."

Modification of Cotton-Seeding Equipment - J. E. Fletcher, Tucson, Ariz.

"Joint work with the Irrigation Division and the University of Arizona was conducted to modify present cotton-seeding equipment to adapt it to rough tillage practice. The modification as it is now being used consists of a set of flat disks (gin saws) spaced 1 inch apart and 7 in a group, mounted between forks so they can be attached to the equipment bar of the tractor ahead of the seeder shoe. With this modification a stand of cotton may be obtained in soil which has only been plowed and irrigated ahead of planting. The surface of the soil is thus undisturbed except in a 6-inch strip. It is expected that this same modification can be used for sorghums and other crops."

Beef Grazing Experiment - H. L. Borst, Wooster, Ohio

"A report of the beef grazing experiment carried on at Zanesville is rewritten for the last time and is now in the print shop. The 5-year summary of this work shows that on grass-legume pastures reclaimed from unproductive hill land the steer averaged approximately 200 pounds of beef per acre of pasture. Daily gains on the hay-type pastures established by trash mulch seeding were nearly 2 pounds a day without corn and a little more than 2 pounds when a light ration of corn was fed."

Effect of Mulching on Soil Temperatures and on Losses of Soil Water by Evaporation Under Conditions Incident to the South Coast of Puerto Rico - J. Vicente-Chandler, Rio Piedras, Puerto Rico

"The consumptive use tanks at Aguirre were used for this experiment. Losses of water by evaporation from the soil surface over a 5-month period with and without a sugarcane trash mulch at two levels of soil moisture were determined. The moisture levels consisted in allowing the soil to dry out to moisture tensions equivalent to about one-half and one atmosphere respectively before wetting.

"Surface intake-rates were determined for the soil in eight of the tanks at the conclusion of the experiment. Complete weather records were kept at the adjacent weather station.

"The effect of the mulch in reducing losses of water by evaporation is highly significant. This practice reduced losses to less than half of those from bare soil. Open pan evaporation during the same period was over two and a half times higher than that from bare soil.

"It is of interest to note that most of the water lost by evaporation comes from that already in the root zone. In a sense most of it constitutes a net loss being in addition to that due to runoff, percolation, etc. If we consider that only 40 percent of the water applied by irrigation is held in the root zone, every inch saved by reducing evaporation actually means a saving of about 2.5 inches of irrigation water. The reduced evaporation due to mulching may therefore mean an annual saving of over 30 inches of irrigation water per acre.

"In the tanks with no mulch the moisture levels as used had no significant effect on water losses through evaporation over the period studied. This is explained by the fact that it was impossible to maintain the different moisture levels

over prolonged periods due to rainfall. The soil in the mulched tanks did not dry out sufficiently at any time during the course of the experiment to permit the establishment of the moisture levels as planned."

DRAINAGE AND WATER CONTROL DIVISION

Hydrologic Studies - L. L. Harrold, North Appalachian Experimental Watershed, Coshocton, Ohio

"Precipitation fell on 19 days of this month totaling 2.97 inches. Runoff occurred from most watersheds resulting from high soil-moisture content and low permeability rates. Land use had no perceptible effect on runoff except for wooded areas as follows:"

Watershed No.	Soil type	Land use	March runoff
			Inches
132	Keene	Woods	0.02
103	Keene	Rotation meadow	.19

Hydrologic Studies - R. B. Hickok, Lafayette, Ind.

"Runoff-water losses for the 10 years of record, 1942-51, have been summarized according to crop and rotation periods, sub-divided between dormant and growing seasons, and are included in the following table, appearing on page 9. It is interesting to note that the runoff losses for the 4-year crop rotation period have been reduced more than 50 percent by the conservation system of management; also that slightly more than half the water losses have occurred during the dormant seasons of the year, despite the relatively low runoff potential of late fall, winter, and early spring precipitation in this region. It seems apparent that the approximately 9 inches of additional water retention on the conservation-treated watersheds during the 4-year rotation period has been largely offset by increased crop consumption in increasing the yields of these watersheds by 35 bushels of corn, soybeans 8 bushels, wheat 6 bushels, and hay 0.8 ton per acre. Any long-term net effects on accretions to ground water, return flow to stream and removal by artificial drainage must have been small, although their distributions have been affected.

"Mr. Stoltenberg has prepared the following additional discussions of 'Selective Loss of Soil Nutrients by Erosion':

"Middleton, Slater, and Byers reported in 1943 that the mechanical composition of eroded material varied with the amount eroded and concluded that slight erosion may be relatively more detrimental to fertility than severe erosion. This conclusion has since been substantiated by several studies on the loss of plant nutrients by erosion. Nevertheless, the effects of selective erosion do not seem to be generally recognized.

"Evaluation of erosion losses in tons per acre is common and may be quite misleading in areas where fertility is high and runoff rates are generally low. There are, in fact, pedologists who still consider that normal erosion is a beneficial soil forming process in that the 'inactive' residues are thus removed.

Table 1.--Summary of runoff-water losses from experimental watersheds under crop rotation, Purdue-Throckmorton Farm - Lafayette, Ind., 1942-51

Crop[1] (Years of record)	Type of soil management	Runoff in inches: Growing Mean	Growing Extremes		Dormant Mean	Dormant Extremes		Total Mean	Total Extremes	
Corn	Prevailing	2.5	0.0	5.1				2.5	0.0	5.1
(9)	Conservation	.9	0.0	2.9				.9	0.0	2.9
	Difference	1.6	0.0	4.2				1.6	0.0	4.2
Fallow	Prevailing				3.0	0.9	5.0	3.0	0.9	5.0
(5)	Conservation				1.8	.2	6.6	1.8	.2	6.6
	Difference				1.2	-1.6	3.3	1.2	-1.6	3.3
Soybeans	Prevailing	1.7	0.6	3.8				1.7	0.6	3.8
(5)	Conservation	.7	.0	2.1				.7	.0	2.1
	Difference	1.0	0.5	1.7				1.0	0.5	1.7
Wheat	Prevailing	2.1	0.1	5.0	1.6	0.2	4.0	3.7	2.0	5.7
(7)	Conservation	.9	.0	3.3	.7	.0	2.0	1.6	.4	3.4
	Difference	1.2	0.1	2.9	0.9	0.2	2.0	2.1	1.1	3.9
New	Prevailing	0.9	0.0	1.9	2.2	0.0	6.1	3.1	0.2	7.0
Meadow	Conservation	.7	0.0	2.0	1.1	0.0	3.2	1.8	.2	3.8
(6)	Difference	0.2	-0.1	0.6	1.1	0.0	3.0	1.3	0.1	3.2
Established	Prevailing	0.8	0.0	1.6	2.0	0.0	6.1	2.9	0.6	7.1
Meadow	Conservation	.3	.0	.6	1.0	.0	2.2	1.3	.2	2.5
(6)	Difference	0.5	0.0	1.1	1.0	-0.1	3.9	1.6	-0.1	4.6
Rotation	Prevailing	8.0			8.8			16.8		
Totals	Conservation	3.5			4.5			8.0		
	Difference	4.5			4.3			8.8		

[1]Crop Periods: Corn -Breaking of meadow to corn harvest or killing frost.
Fallow -Intervening period between corn & soybeans (corn stalk cover).
Soybeans -Seedbed preparation to harvest.
Wheat -Soybean harvest to wheat harvest.
New Meadow -Wheat harvest to following May 1
Established Meadow-May 1 to breaking for corn, following spring.

"In reporting losses of plant nutrients the ratio of the particular nutrient in the eroded material to that in the soil has been used. These ratios obtained at several locations have been quite variable. It appears that there are three dominant factors which influence this ratio: (1) The kinetic energy of the runoff; (2) the texture and degree of aggregation of the soil; (3)the availability of a particular soil fraction to surface runoff.

"We have developed curves that relate concentration of total solids in individual runoff samples (an index of the kinetic energy of the runoff) to the nitrogen content of the eroded material. These curves can be obtained from the project if so desired. Similar curves have been developed for organic matter and the major plant nutrients. These curves show that the ratio would be expected to vary, depending on soil and runoff conditions during the period of time under study.

"These curves further indicate that the selective nature of the erosion process as well as the concentration of eroded material in the runoff are the result of energy limitations of runoff. This conclusion is supported by the nitrogen-content curve from the conservation-practice watersheds, which lies considerably above that from the prevailing-practice watersheds. One of the effects of contour cultivation is to reduce the hydraulic gradient of the runoff with a decrease in its kinetic energy. Further details of the selective-erosion process will be presented in a subsequent report."

Hydrologic Studies - Geo. Crabb, Jr., East Lansing, Mich.

"Precipitation for the month of March, as measured by the U. S. Weather Bureau type of standard nonrecording rain gages, amounted to 2.08 inches at the cultivated watersheds, 2.09 inches at the wooded watershed, and 2.15 inches at the stubble-mulch plots. These amounts are approximately 89 percent, 89 percent, and 91 percent, respectively, of the 50-year average March precipitation of 2.35 inches. March precipitation can be expected to equal or exceed 2.08 inches once in 1.70 years.

"There were 10 runoffs during the month, 4 from watershed 'A' and 6 from watershed 'B,' occasioned by thawing of winter snow and/or fresh precipitation. Watershed 'A' lost approximately 1.74 inches as runoff, and watershed 'B' lost approximately 0.76 inch. Soil loss, though not yet computed, seems to have been minor.

"Snowfall for the winter of 1951-52 is, as of March 31, the second highest for one winter on record at East Lansing, totaling more than 79 inches. This is actually the greatest amount of snow recorded to have fallen by this date, but one season's snowfall exceeded this amount, by extending through the month of May.

"During the month final preparation of two manuscripts was completed, and the manuscripts sent to Washington for clearance following release by the Michigan Agricultural Experiment Station. These manuscripts were, 'Comparative Tillage Tests at East Lansing, Michigan - A Progress Report,' written in collaboration with Dr. James Tyson, Department of Soil Science; and 'A Progress Report on the Wooded Watershed: Michigan Hydrologic Research Project,' written in collaboration with Mr. James L. Smith, Graduate Research Assistant, Michigan State College Department of Forestry. The paper on tillage tests is planned for publication in 'The Quarterly Bulletin of the Michigan Agricultural Experiment Station,' as is the wooded watershed report. However, the report on the wooded watershed will be first delivered as a paper before the Michigan Academy of Science, Arts, and Letters, at Ann Arbor on April 11, 1952.

"A monolithic soil sample was obtained for use in studying the effect of freezing temperatures on the behavior of plaster-of-paris soil-moisture determining units. This test, using a commercial ice cream box, is scheduled to be carried out early next month. The tests of the suitability of plaster-of-paris units for the determination of water content of snow, being carried on at the request of Project Supervisor L. L. Harrold, have been completed, and conclusions are being drawn therefrom.

"A normal annual pattern of daily rates of evaporation was developed, utilizing daily evaporation and sublimation records for the period of 1946-52. It will be noted that this pattern is developed from 2 more years of daily data than that presented in Messrs. Baten and Eichmeier's bulletin, and discussed in last month's monthly report. The pattern was arrived at much in the manner of that developed for solar radiation; i. e., average daily values of the rate of evaporation were arithmetically arrived at for each day of the year. Through use of the 15-day moving average, these arithmetic averages were "smoothed" to give a normal curve of daily values for any year. A tabulation of these values is attached, as is a plot of the values in comparison with a plot of the normal solar pattern. It will be noted that there is an extremely close correlation between the two curves. In cooperation with Dr. Baten, project personnel are currently conducting a study to determine the mathematical relationship of the daily values for these two curves, evaporation and solar radiation, in an effort to develop a formula or formulae that will permit the determination of either factor from a knowledge of the other. This offers interesting and useful applications in the prediction of evapo-transpiration rates."

Hydrologic Studies - R. W. Baird, Blacklands Experimental Watershed, Waco, Tex.

"During the month of March the total rainfall at Gage No. 69 was 3.23 inches compared to a normal of 3.08 inches. Total rainfall for the first quarter of 1952 is now slightly above the average. For these 3 months, however, there is still no great amount of moisture except in the surface 24 to 36 inches, and timely rains will be required to keep pastures and field crops making satisfactory growth.

"The rains for the month of March caused no runoff except at Station C and D in the upper part of the Brushy Creek Watershed. The amounts of runoff at these two stations were very small.

"The largest rain during this period was 1.11 inches on March 10 and the remainder of the rainfall occurred as numerous light showers.

"Light rains during the month increased the moisture supply down to a depth of 36 inches on cultivated areas. Oatland is still deficient in moisture. However, the seasonal rainfall has been sufficient to keep them growing and promising.

"Most of the corn is up to a good stand and grain sorghum is coming up. Oats are beginning to head, which is about a week early for this area. The prospects for an average field is fair. The stand is good. The permanent pasture areas are furnishing ample grazing for the cattle. Bluebonnets in the meadows are in full bloom."

Hydrologic Studies - J. A. Allis, Central Great Plains Experimental Watershed, Hastings, Nebr.

"Measurable amounts of precipitation, all of less than 1/2 inch, were recorded on 9 days during March. Traces were recorded on 5 other days. The total precipitation was 1.85 inches for the month. Rains in the early part of the month indicated there was considerable dust in the air which was evident by dirt on the windshields following the showers. On March 22, a blizzard occurred which closed some State highways for as long as 60 hours. Snow from the wheat fields and land of little or no cover was swept off and accumulated in road cuts and along tree strips as high as 8 feet. Farming operations were started the last of the month while there were still drifts of snow in the protected areas.

"Gage height computations have been completed on 20 of 24 small 4-acre watersheds for the 6-week period, June 1 to July 12, 1951, during which period about 15 inches of rain fell on the area. As soon as the computations are completed, a table will be prepared showing the differences in total runoff for this period under different land use practices.

"An article on the 'Story of Two Watersheds' is in the process of being cleared by the Washington office for possible publication in the SOIL CONSERVATION magazine. This article gives the factual data on runoff obtained on a 411-acre mixed cover watershed 65 percent under conservation practices as compared to a 481-acre untreated area for the period June 1 to July 12, 1951."

Runoff Studies - N. E. Minshall, Madison, Wis.

"Precipitation at Edwardsville totaled 6.06 inches and the surface runoff totaled 4.05 inches. Over one-half of this total runoff occurred on March 31 as a result of a 2-3/4-inch rain in the period of 2-1/2 hours. The maximum amount during the latter part of this storm was 1.2 inches in 23 minutes. Peak rates of runoff were:

W-I	27 acre	-	2.06 inches per hour
W-II	50 acres	-	2.28 inches per hour
W-IV	290 acres	-	1.60 inches per hour

"Mr. J. P. Corbin, engineer of the Wisconsin Conservation Dept., was in the office on March 18 to obtain information on estimated peak rates and amount of runoff from a 42-squarge mile drainage area in southwestern Wisconsin. The Conservation Department is planning a recreational reservoir on this watershed; a storage between spillway elevation, and maximum water level for the design flood will be approximately 1-1/4 inches from the entire drainage area."

Hydraulic Studies - F. W. Blaisdell, Minneapolis, Minn.

"Two 3-day training conferences were held during March; the first on March 11, 12, and 13 and the second on March 25, 26, and 27. The first conference was attended by a professor from the University of Illinois, two members of the Agricultural Engineering staff of Iowa State College, engineering specialists from Montana and North Dakota, and Work Group Engineers from North Dakota, Illinois, and Minnesota. The second conference was attended by the Regional Engineer in Region 1; the Regional Design Engineers in Regions 1 and 4; the Regional Agricultural Engineer in Region 4; Engineers from the Water Conservation Division and

the Projects Plans Division in Region 3; Engineering Specialists from Indiana and Ohio and Work Group Engineers from Michigan and Ohio. The training was given by means of lectures, moving pictures, and demonstrations on working models. Subjects covered included the hydraulics of box inlet spillways, straight drop spillways, closed conduit spillways, dimensionless numbers, the theory of the hydraulic jump, and the design of transitions and the SAF spilling basin. We have now trained a total of 129 engineers in the hydraulics of soil conservation structures. The demand for these training conferences continues and shortly after the first of the fiscal year we plan to send a circular letter to the various regions asking how many men they would like to send to a similar conference and when would be the most convenient date.

"A technical paper describing the box inlet drop spillway was formally cleared for publication during the month and was submitted to the American Society of Civil Engineers on March 17."

Drainage Studies - J. C. Stephens, West Plam Beach, Fla.

"Several days were spent in company with Everglades Experiment Station and Fish and Wildlife Service personnel examining the Loxahatchee Wildlife Refuge Area and in planning field trials for various plantings of game food in the Loxahatchee Wildlife Refuge Area. A plan was worked out whereby a number of plantings of rice will be made in strips, at 2-week intervals and at various water levels, in the area beginning next month. It is planned to utilize airboats for sowing and fertilizing the seed rice and it is thought that sufficient covering will be given by the backwash from the airboat. If this plan is successful, it will mean that many acres of strip plantings can be made at very reasonable cost. This should increase the feeding capacity and attractiveness of the area, which is the souther most refuge on the South American flyway for ducks, geese, and other water fowl.

"The 17th North American Wildlife Conference held at Miami, Fla., was attende During this meeting, observations that game fish left drainage ditches whenever the water was drained down whereas the rough fish remained was discussed with specialists representing various wildlife organizations. The fact that the fish will ordinarily behave in this manner was confirmed and a technical paper was subsequently prepared, in cooperation with personnel of the Everglades Experiment Station, describing the studies made with the use of aromatic herbicides for the treatment of drainage ditches containing naiad growth, and the possibility of manipulating the water level in the draws prior to treatment for preservation of the game fish.

"It was pointed out in the paper that the solvent WS-1492, applied at the rate of about 250-350 ppm, gave a satisfactory control of the submerged weed. The dense growth sank to the bottom of the ditch and commenced disintegrating a short time after treatment, thus permitting free movement of water in an open channel. Two weeks after application, approximately 95 percent of the plants were dead and 2 months later there was little evidence of regrowth. It is estimated that a ditch properly treated with WS-1492, which is a petroleum oil containing 99.50 per cent aromatics, will remain comparatively free from extensive regrowth of naiad for a period of 3 to 4 months.

"The possible key to control of game fish in some cases may have been uncovered, it is believed, during lowering of the water level in the channel prior to spraying. The level was lowered to permit concentrated application of the herbicide. It was observed, as soon as the lowering of the level was begun, that the

game fish fled to deeper waters while the rough fish, gar and mud, remained behind. After the tests, a large number of garfish and several minnows were found dead in the treated plots. As a result, it is believed that rough fish may possibly be controlled in water channels where game fish can first temporarily escape to deeper water while the drainage ditches are being treated.

"It is believed that the solvent, WS-1492, may prove superior to many other chemicals used in aquatic treatment since after the emulsion breaks, this solvent rises and evaporates leaving the water relatively unpolluted.

"A trip was made to Ritta Island in Lake Okeechobee, and arrangements made with the landowners to begin subsidence surveys on the island after the crops are harvested in late spring or early summer. The soil on this island is Okeechobee muck and indications are that subsidence rates for this soil are less than for the peat soils in the Everglades proper. The approximate position of the old 17 foot meander line as located by the 1913 survey is available. Also levels run over the island during 1940 by the Corps of Engineers have been obtained from the District Office at Jacksonville. Our resurvey this year should give much additional information on subsidence in this type of soil.

"At the Everglades Experiment Station, several herbicides were tested on the Najas samples in battery jars in the greenhouse. The treatments giving satisfactory reactions were the two WS-1492 applications. The herbicides and their concentrations were:

Herbicide	Concentrations
Beneclor 3	150, 300 ppm
WS-1492	150, 300 ppm
Borasen	1500, 3000 lbs/acre
Polybor-Chlorate	1500, 3000 lbs/acre
CMU	25, 50, 75 lbs/acre
Shell Weed Killer 130	150, 300 ppm
90% Sodium TCA	75, 150 lbs/acre (active)
40% Isopropyl TCA	7.5, 15 gal/acre
Crag-1	10 lbs/acre
H 2-73	10 lbs/acre

"The jars will be cleaned and replanted with fresh material for additional trials. Higher concentrations of some of the above herbicides will be tested as well as some new types."

Drainage Studies - M. H. Gallatin, Homestead, Fla.

"Reading of our well lines for March 31 show that the water table was from 1 foot to 3 feet higher this year than it was for the previous years for which records are available. For the Everglades profile, readings show that the water table is slightly lower this year than for the past several years.

"Readings at Well #5 show that the water table this year was from 1.03 to 1.89 feet higher than that of the previous year's records available.

Nitrate Leaching Studies - "Samples collected a week after the heavy rains of March 26-28 showed that in the more open lime groves losses were quite heavy. Block 3 of Redd Grove dropped from 248 to 95 ppm. Losses in the Avacado groves were not as high in the canopy samples because of the much heavier canopy of leaves. Samples collected from the centers between rows showed high losses.

Water Control on the Deep Marl Land in South Florida - "Rainfall for the period March 26 through 28 varied from 3.18 at Highlands to 4.28 inches at the Goulds Canal gage. Much of the area still in crops was inundated by these rains. On the plot area the ditches held the run off easily but because weather conditions looked like rain, the 2,000 G. P. M. was started and run for 5 hours to pull the water down in the ditches so there would be storage in case of additional rains.

"In the areas that were ditched and diked the only losses were in small depressional areas where as in the areas with no ditches the damage to beans and tomatoes was extensive.

"During the late winter, several more areas have been ditched and diked using the Marl seat type of ditch."

Drainage Studies - I. L. Saveson, Baton Rouge, La.

"The Annual Report for 1951 has been completed and the following is a summary of the year's results:

"The project's results for 1951 are not as authentic as is desired due to the early freeze. The frozen cane had various degrees of deterioration depending on the lapse of time between the freeze and harvesting. The dry season also tempered the results. The results are indicative and the following is evident:

1. It is feasible to grade problem areas which require considerable earth moving. The 1951 results indicate that $113.00 per acre can be expended and paid off the first year. The conclusion is based on a comparison of prior yields of the area.

2. It is feasible to grade sugar cane land taking advantage of the side fall of the field having the cuts slope from ditch to ditch. An increase yield of 7.44 tons per acre was obtained on a precision graded area with a slope of 0.2 foot per 100 feet from ditch to ditch.

3. It has been questioned whether the benefit of grading work was not primarily due to a tillage effect rather than a drainage effect. On St. Delphine Area 3, one block was smoothed and deep tilled and the balance of the area was graded, smoothed, and deep tilled. The latter area had an increase in yield of 4.74 tons per acre over the first. This definitely proves that the increased yields are due to the drainage effect grading that there is a tillage benefit since the smoothed and deep tilled area out-yielded the unworked check area.

4. The flat planted area on graded land out-yielded the row planted area on graded land by 4.59 tons on light land and 0.31 ton on blackland. No maintenance of the quarter drains was required after planting. This is only one season's work and 1951 was a dry year.

"The sucrose analysis of preharvest sampling and testing indicated approximately one point higher sucrose on the flat planted area. Since this is only 1 year's results, definite conclusions cannot be made and further studies will be required. The test also points to the need to make a study of the water relations between flat planted areas versus row planted areas to ascertain the evaporation, surface water movement, infiltration, moisture relationship and effect of rainfall impact.

5. The contacts with the public and the Contact Committee of the American Sugar Cane League indicate a very wide interest in the grading work. Field observations reveal considerable amount of the work being done with various degrees of precision. District conservationist of the Service working in the cane territory reports the same.

6. A preliminary run was made in grading sugar cane land being converted to pasture. The first run was approximately $60 per acre which is exorbitant. Further trials will develop techniques which will reduce this cost. Pasture grading trials are contemplated for the summer of 1952, to develop the required techniques.

7. There is considerable interest in the cotton area of Louisiana in grading land to improve drainage. The survey made at Tallulah indicates a need for the experimental work to be expanded to this area. No definite information is available on the benefit of grading cotton land and the required techniques to execute the work. The project work has not been extended to this area since the limited funds are not adequate for the present study of drainage of sugar cane land."

Drainage Studies - C. B. Gay, Fleming, Ga.

"Seepage studies are being conducted across the foot of the slope on Plot 41 which is in sericea, to determine the degree of seepage on the adjacent low area which stands in water almost the entire year. This study consists of a series of six lines of post holes spaced every 15 feet down the slope, and the water level measured each afternoon. This information will aid in determining the location of a ditch to intercept any appreciable seepage from the lower area."

Sedimentation Studies - R. Woodburn, State College, Miss.

"Sounding on Norris Lake near State College was completed after several periods of waiting in order to have days with the wind low enough to operate efficiently and safely.

"The lake bottom is a heavy clay with very little sediment deposited. There was a great deal of difficulty in identification of the original bottom. Some ranges may need to be re-run.

"A study was made of inflow and flood routing on the lake. With a gross watershed area of 319 acres and a water surface area at spillway elevation of 48.5 acres, it was thought that the standard methods would not work so well. With about 6,000 feet of shore line, there would be about 65 acres within 400 feet of the water surface. It was decided to divide drainage area into 200-foot wide strips beginning at shore line and working back through the drainage area. There were about 18 such strips with the most remote part of area about 3,600 feet from the shore line. A Yarnell 25-year rain was applied to a strip and runoff was computed by

infiltration theory and an assumed overland velocity rate of 100 feet per minute. The flow was routed from strip to strip in order to secure the inflow to lake. Then a correction for 'rain in' to the lake was added to the hydrograph. The storage here is tremendous in proportion to drainage area and most of inflow goes as storage since the outflow structure is a 26-foot wide broad-crest weir. When weir stage reaches 0.8 foot water spills around club house in a gap about 100 feet wide. Maximum inflow rate was computed to be 625 c. f. s. from drainage area or 725 c. f. s. with rain in correction.

"Maximum outflow rate is 155 c. f. s. at a stage of 1.08 feet on weir, reached 121 minutes after start of design rain with 56 acre-feet storage above spillway elevation.

"On March 10 Mr. Burford and I visited Thompson Creek in Carroll County during the latter stage of runoff from a rain of approximately 2 inches.

"We were able to set water level points near crest stage of creek at our two standard observation points. We were also able to take a few sediment samples.

"Maximum central surface velocity was noted as 7 f. p. s. on the upper gage station. The mean velocity was estimated, and the slope of the water surface and energy gradient determined. It is hoped that many more such observations may be made as the project continues.

"Sediment samples were taken at the McCarley bridge on Thompson Creek and analyzed with following results. A few samples were also taken in Magic Creek and near the surface of Big Sand Creek at McCarley. The velocity was so high on Big Sand (below 25 sq. miles) that the sampler could not be controlled with penetration deeper than about 1 foot in water. Results of these samples can be obtained from the project."

IRRIGATION ENGINEERING AND WATER CONSERVATION DIVISION

Irrigation Studies - K. Harris and H. B. Peterson, Phoenix, Ariz.

"Uhland core samples were taken at the lettuce tillage experiments being conducted on the Mesa Farm. Infiltration rates and specific gravities were determined. Cultivation had a very definite effect on the percolation rates in these treatments.

"Lettuce yellowing has occurred in many of the fields of the Valley. Because of recommendations made by this office and the University of Arizona Experiment Station, it has not been as prevalent this year as in years past. A call was made recently by a farmer in whose field this condition occurred. Uhland core samples were taken, and infiltration rates and apparent specific gravities determined. It was found that conditions prevailed here similar to those found in all other fields having lettuce yellowing, i. e., a very severe hard pan was found between 9-12 inches, which retarded the movement of water and salts below the depth. This 9-12-inch layer had a percolation rate 40 times slower than the layer above it."

Irrigation Studies - D. W. Bloodgood, Austin, Tex.

"A tentative draft of the manuscript for the proposed publication 'Irrigation and Use of Water for Rice in Texas' has been practically completed. Copies are being prepared which will be sent to rice, irrigation, and other agencies for their comments, suggestions, and criticism before the final draft is made for multilithing.

Table 1.--Summary of estimated consumptive use and net irrigation requirements for rice grown in the principal areas during the season of 1951 (Using the Blaney-Criddle method and formula)*

Area	Average irrigation season 1/	May (M) U 3/	May (M) R 4/	May (M) N 5/	June (J) U	June (J) R	June (J) N	July (J) U	July (J) R	July (J) N	August (A) U	August (A) R	August (A) N	September (S) U	September (S) R	September (S) N	Total consumptive use of water	Total net irrigation requirements
		In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Beaumont	(1)	6.08	2.55	3.53	6.24	0.57	5.67	5.93	4.25	1.68	6.70	2.19	4.51				24.95	15.39
	(2)				6.24	.57	5.67	5.93	4.25	1.68	6.70	2.19	4.51	3.97	14.08		22.84	--
Katy-Brookshire	(1)	6.04	2.04	4.00	7.00	4.03	2.97	8.26	1.16	7.10	8.64	0.66	7.98				29.94	22.05
	(2)				7.00	4.03	2.97	8.26	1.16	7.10	8.64	.66	7.98	5.10	10.66		29.00	--
Eagle Lake	(1)	6.14	2.04	4.10	6.91	4.03	2.88	8.24	1.16	7.08	8.59	.66	7.93				29.88	21.99
	(2)				6.91	4.03	2.88	8.24	1.16	7.08	8.59	.66	7.93	5.10	10.66		28.84	--
Alvin-Pearland	(1)	6.05	2.17	3.88	7.61	1.62	5.99	7.39	1.17	6.22	8.22	1.29	6.93				29.27	23.02
	(2)				7.61	1.62	5.99	7.39	1.17	6.22	8.22	1.29	6.93	4.32	8.63		27.54	--
Palacios-El Campo	(1)	6.04	4.25	1.79	7.62	1.94	5.68	8.16	2.84	5.32	8.51	1.00	7.51				30.33	20.30
	(2)				7.62	1.94	5.68	8.16	2.84	5.32	8.51	1.00	7.51	4.76	11.34		29.05	
Edna-Pt. Lavaca	(1)	6.06	2.29	3.77	7.64	4.68	2.96	8.21	1.34	6.87	8.51	1.08	7.43				30.42	21.03
	(2)				7.64	4.68	2.96	8.21	1.34	6.87	8.51	1.08	7.43	4.76	5.86		29.12	
Mean for Texas for season 1951	(1)	6.07	2.56	3.51	7.17	2.81	4.36	7.70	1.99	5.71	8.20	1.15	7.05	4.67	10.21		29.14	20.63
	(2)																27.74	

1/ - Two seasons: (1) for early rice, months of M, J, J, A; (2) for late rice, months of J, J, A, S.
3/ - U: consumptive use
4/ - R: rainfall
5/ - N: net irrigation requirements

* Consumptive use of water formula U = KF

U -- consumptive use of crop for growing season or period in inches;

K -- coefficient for individual crop for growing season or period (used K = 1.20 for 1951 data - Blaney's estimate - Table 2 on Consumptive Use Coefficient (K) for Irrigated Crops in Western States in paper entitled 'Irrigation Requirements of Crops' presented at annual meeting of American Society of Agricultural Engineers, Houston, Tex., June 20, 1951. For rice he estimated lower value for K (1.00) for coastal areas and higher value for K (1.20) for areas of an arid climate.)

F -- consumptive-use factor (sum of mean monthly temperature 't' times monthly percent 'p' of annual daytime hours for growing season or period.)

Table 2.—Summary of estimated consumptive use and net irrigation requirements for rice grown in the principal areas during a long-time mean (using the Blaney-Criddle method and formula)*

Area	Average irrigation season 1/	May (M) U 3/	May (M) R 4/	May (M) N 5/	June (J) U	June (J) R	June (J) N	July (J) U	July (J) R	July (J) N	August (A) U	August (A) R	August (A) N	September (S) U	September (S) R	September (S) N	Total consumptive use of water	Total net irrigation requirements
		In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.
Beaumont	(1)	7.21	5.28	1.93	7.76	4.48	3.28	8.08	5.70	2.38	7.72	5.40	2.32				30.77	9.91
	(2)				7.76	4.48	3.28	8.08	5.70	2.38	7.72	5.40	2.32	6.69	4.31	2.38	30.25	10.36
Katy-Brookshire	(1)	7.20	4.06	3.14	7.73	3.32	4.41	8.09	3.77	4.32	7.71	3.07	4.64				30.73	16.51
	(2)				7.73	3.32	4.41	8.09	3.77	4.32	7.71	3.07	4.64	6.61	3.45	3.16	30.14	16.53
Eagle Lake	(1)	7.25	4.06	3.19	7.78	3.32	4.46	8.15	3.77	4.38	7.81	3.07	4.74				30.99	16.77
	(2)				7.78	3.32	4.46	8.15	3.77	4.38	7.81	3.07	4.74	6.66	3.45	3.21	30.40	16.79
Alvin-Pearland	(1)	7.05	4.05	3.00	7.55	3.93	3.62	7.92	5.52	2.40	7.54	4.10	3.44				30.06	12.46
	(2)				7.55	3.93	3.62	7.92	5.52	2.40	7.54	4.10	3.44	6.51	4.56	1.95	29.52	11.41
Palacios-El Campo	(1)	7.21	4.26	2.95	7.69	1.48	6.21	8.01	3.08	4.93	7.69	5.08	2.61				30.60	16.70
	(2)				7.69	1.48	6.21	8.01	3.08	4.93	7.69	5.08	2.61	6.66	3.94	2.72	30.05	16.47
Edna-Pt. Lavaca	(1)	7.24	4.24	3.00	7.71	3.62	4.09	8.06	3.77	4.29	7.73	2.68	5.05				30.74	16.43
	(2)				7.71	3.62	4.09	8.06	3.77	4.29	7.73	2.68	5.05	6.67	0.87	5.80	30.17	19.23
Long-time mean for Texas	(1)	7.19	4.32	2.87	7.70	3.36	4.34	8.05	4.27	3.78	7.70	3.90	3.80	6.63	3.43	3.20	30.65	14.80
	(2)																30.09	15.13

1/ - Two seasons: (1) for early rice, months of M, J, J, A; (2) for late rice, months of J, J, A, S.
3/ - U: consumptive use
4/ - R: rainfall
5/ - N: net irrigation requirements

* Consumptive use of water formula U = KF

U — consumptive use of crop for growing season or period in inches;

K -- coefficient for individual crop for growing season or period (used K = 1.00 for long-time average - Blaney's estimate, Table 2 --- see same reference as for Consumptive Use for 1951).

F -- consumptive-use factor (sum of mean monthly temperature 't' times monthly percent 'p' of annual daytime hours for growing season or period).

Comments by readers of this report in the Monthly Summary will be appreciated."

Irrigation and Drainage Research in Utah - V. E. Hansen, Logan, Utah

"At the request of the irrigation specialist for Operations of the State of Utah, preliminary hydraulic tests were made on oil-type spigots which have been proposed for irrigation outlets to concrete pipe in the Box Elder Valley. Since leakage is prevented by a spring loaded plate covering the orifice, the larger the valve, the greater the total pressure acting on the plate and consequently the greater the leakage. Tests indicate that neither the 3/4 nor 1-1/4-inch valve will leak at a pressure of 25 lbs. per square inch, whereas the 1-1/2-inch valve begins to leak at about 10 lbs. per square inch and the 2-inch at about 8 lbs. per square inch. At 25 lbs. per square inch, the 1-1/4-inch valve leaks approximately 200 drops per minute while the 1-1/2-inch leaks 0.01 gpm and the 2-inch leaks 0.5 gpm. Since the seal depends upon a tight fit between the plate and the base of the orifice, it is thought that any sediment carried in the stream will contribute to the unsatisfactory operation of the valve. The jet issuing from the valve, particularly under a partial opening presents a particularly troublesome problem due to the resulting erosion. Present indications are that the valves will probably not operate satisfactorily over 8 lbs. per square inch and in streams carrying an appreciable amount of foreign matter.

"A paper entitled 'Complicated Well Problems Solved by the Membrane Analogy,' which was recently submitted to the American Geophysical Union has been accepted for discussion at the annual meeting to be held in Washington, D. C., on May 5-7. Following is an abstract of this paper:

"The two general types of well flow, confined and unconfined, are outlined for steady flow. The membrane theory is presented and the experimental equipment and results outlined. It is shown that the membrane analogy will yield solutions to complicated problems associated with both basic types of well flow. The principles of model design necessary to duplicate the existing boundary conditions are presented.

"A thin rubber membrane can be used to obtain the shape of the piezometric surface for confined flow and the free surface for unconfined flow near the well where the linear logarithmic solution holds.

"The simplicity, wide applicability, low cost, accuracy, and adaptability together with the bisual nature of the solution makes the membrane analogy extremely useful in the solution of multiple-well problems with complex approach conditions."

Erosion from Wheat-Alfalfa - S. J. Moch, Prosser, Wash.

Such factors as stream size, soil disturbance, and the cumulative effect of vegetation, time, and previous irrigations influence erosion. How these influences vary throughout the season for wheat followed by alfalfa is shown in table 1 and illustrated in figure 11A (a copy of the figure can be obtained from the project).

"They show the amount of silt that different stream flows carried for each irrigation on wet, medium, and dry plots on 2 percent furrow grade and 7 percent furrow grade. They represent the ability of a given stream to pick up and transport soil for the different conditions during the season. It shows that erosion

Table 1.--Relationship between rate of flow and erosion for 1951 wheat-alfalfa

AVAILABLE SOIL MOISTURE 60% - 100%

Date of irrigation	7% furrow grade						2% furrow grade					
	q		2q		3q		q		2q		3q	
	Runoff Cu.ft/Min.	Erosion T/A	Runoff Cu.ft/Min.	Erosion T/A	Runoff Cu.ft/Min.	Erosion T/A	Runoff Cu.ft/Min.	Erosion T/A	Runoff Cu.ft/Min.	Erosion T/A	Runoff Cu.ft/Min.	Erosion T/A
April 17	0.25	9.08	0.56	14.84	1.10	29.47	0.40	1.12	0.81	5.30	1.29	14.46
May 17	.29	1.40	.62	2.36	1.11	3.08	.32	.74	.83	1.76	1.44	3.94
June 7	.28	1.27	.56	1.81	.96	2.21	.27	.24	.77	.38	1.28	.37
June 21	.29	.19	.54	.36	.90	.57	.32	.12	.79	.17	1.38	.60
Aug. 14*	.05	.68	.29	5.74	.39	12.04	.10	.29	.17	.47	.26	1.20
Sept. 5	.10	.04	.44	.20	.77	.67	.14	.05	.54	.25	.92	.49
Sept. 26	.20	.06	.58	.20	1.01	.30	.25	.04	.68	.10	1.08	.18
AVAILABLE SOIL MOISTURE 35% - 100%												
May 2	0.27	8.08	0.68	18.34	0.88	23.41	0.27	0.90	0.60	2.74	1.06	8.38
June 13	.19	.28	.50	.46	.71	.61	.19	.10	.64	.33	1.10	1.00
Aug. 11*	.06	.64	.27	6.94	.35	12.51	.09	.27	.21	.57	.33	2.64
Sept. 21	.08	.04	.42	.51	.77	.80	.16	.08	.48	.28	.97	.56
AVAILABLE SOIL MOISTURE 15% - 100%												
June 2	0.21	0.60	0.58	4.34	1.04	8.90	0.25	0.31	0.51	0.73	0.81	1.76
Aug. 9*	.08	.64	.19	6.64	.38	14.14	.05	.10	.19	.50	.36	1.69

*This irrigation, the first following wheat harvest, alfalfa seeding and reditching was made in 18-inch furrows. All other irrigations made in 36-inch spacings. Wheat seeded March 16 and harvested July 23. Alfalfa seeded August 9.

varies a great deal throughout the season and that it is greatest for those irrigations following cultivation or reditching or other soil disturbance. It shows also that under some conditions there is practically no erosion even under heavy stream flow.

"The maximum total erosion measured on wheat was 35.32 tons per acre on the 7 percent furrow grade wet plots irrigated four times during the season. The erosion on the corresponding plot on the 2 percent slope was 19.38 tons per acre. (Erosion from last year's corn was 84.06 and 84.40 tons per acre on the 7 percent and 2 percent furrow grade respectively.) The absence of cultivation is the biggest factor contributing to this lesser erosion on the wheat. The fewer irrigations on the wheat have only a minor influence as irrigation in an undisturbed furrow adds very little to the total erosion.

"The maximum erosion from an individual irrigation on the alfalfa seeding amounted to only 3.20 tons per acre on the 2 percent furrow grade, and 14.14 tons per acre on the 7 percent furrow grade. The disturbed soil surface following drilling of alfalfa and reditching made the field very susceptible to erosion by the irrigating stream.

"Applying the first irrigation in 18-inch furrow spacing doubled the amount of erosion that would have occurred from the usual 36-inch spacings since the number of streams and the rate of flow per unit area was doubled.

"Unfortunately, a direct comparison of total erosion from the 2 percent and from the 7 percent furrow grade cannot be made. The comparison should be made only for identical flows. The 'q' flow on the 2 percent furrow grade is greater than the 'q' on the 7 percent furrow grade and the erosion cannot be compared directly. The greater intake on the flatter grade requires a greater irrigating stream and the greater the stream the greater is the erosion hazard. For analysis of similar erosion data, see 'Effect of Slope and Length of Run on Erosion Under Irrigation,' by S. J. Mech, pp. 379-383, 389. Agricultural Engineering, August 1949.

"Delaying an irrigation after any soil disturbance reduces the total erosion. Time, plus the changes that accompany it, tend to develop a resistance to erosion but it does not provide complete control. A comparison of the erosion for the first irrigation on wheat on the wet, medium, and dry plots show a progressively decreased total loss as the first irrigation is delayed. Of course during this time there is some change in vegetative growth, but this decrease in erosion cannot be all attributed to changes in vegetation. Some of it must be due to the natural settling and consolidation that takes place with time.

"A comparison of the results for the June 7 irrigation on the wet plots and the June 2 on the dry shows the difference that time plus previous irrigations cause. We do not know whether the low loss on the wet plot is due to the consolidation by previous irrigation or to the removal of erodible material by the earlier irrigations. Both contribute to a reduced soil loss. One thing is certain that the soil loss for succeeding irrigations is gradually decreasing if no soil disturbance intervenes. This is clearly evident in figure 11A.

"The erosion losses for the August 9, 11, and 14 irrigations on the dry, medium, and wet plots respectively after wheat harvest and following the seeding of alfalfa show surprisingly similar erosion losses. These were made within a few days of each other following the reditching. Here the time differential was small and the resulting losses are practically identical for the wet, medium, and

dry plots. A comparison with the gradually decreasing losses from the first irrigation on the wet, medium, and dry plots on wheat show the influence of time without the benefit of consolidation by wetting."

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